The Future Energy System - The Role of Centralized Technologies

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The Future Energy System

- The Role of Centralized Technologies

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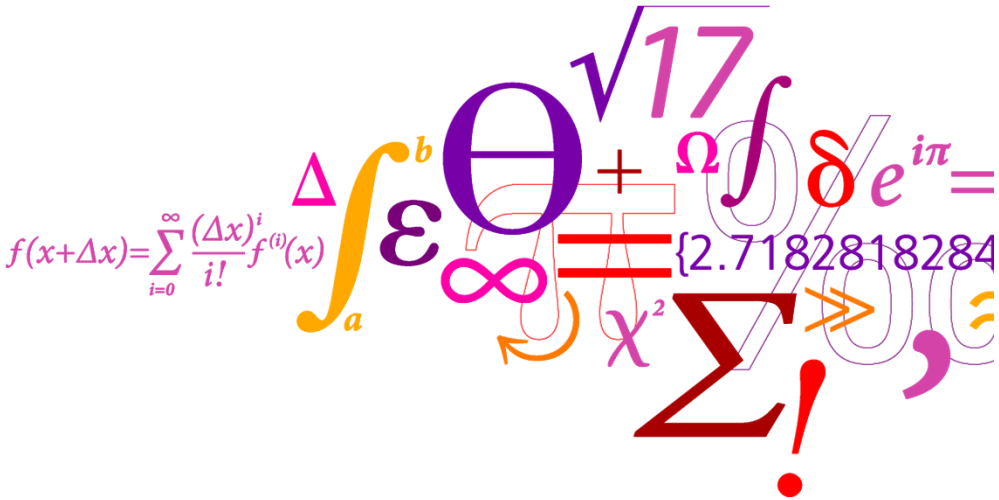

DTU Management Engineering
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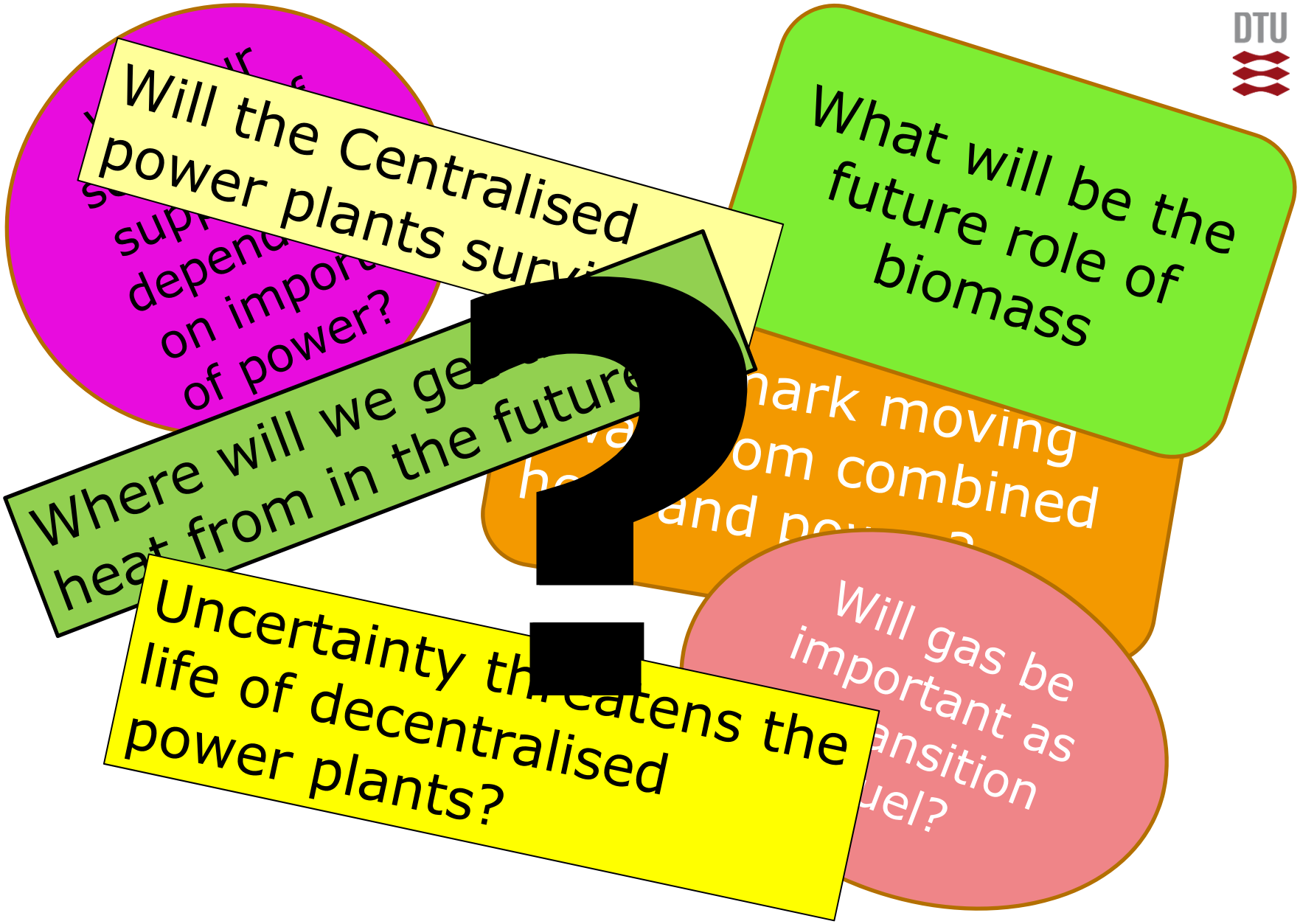
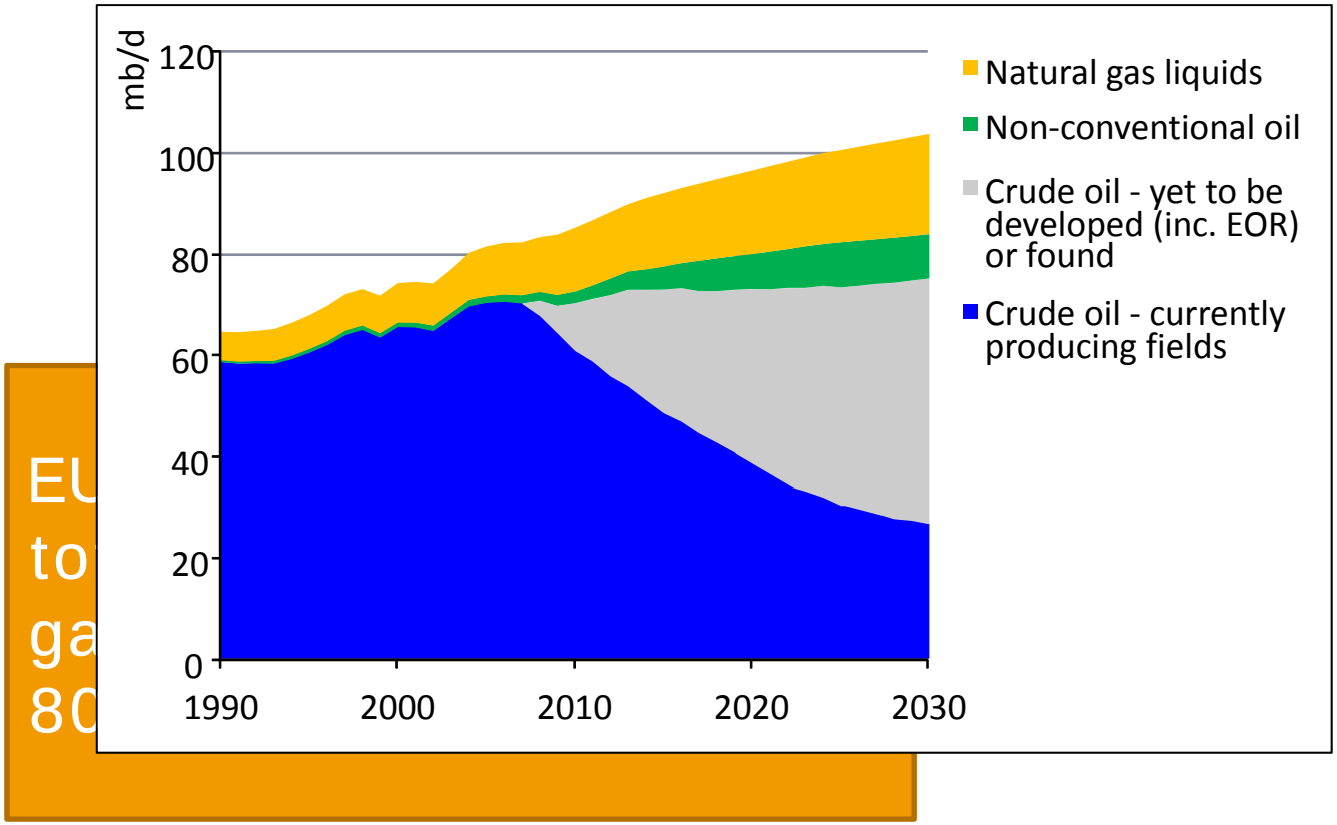

Will the Centralised power plants surv
What will be the future role of biomass
Where will we ge heat from in the future
nark moving om combined and po
Uncertainty th atens the life of decentralised power plants?
Will gas be important as ansition uel?

Starting point for the Commission on Climate Change Policy:



Main Message

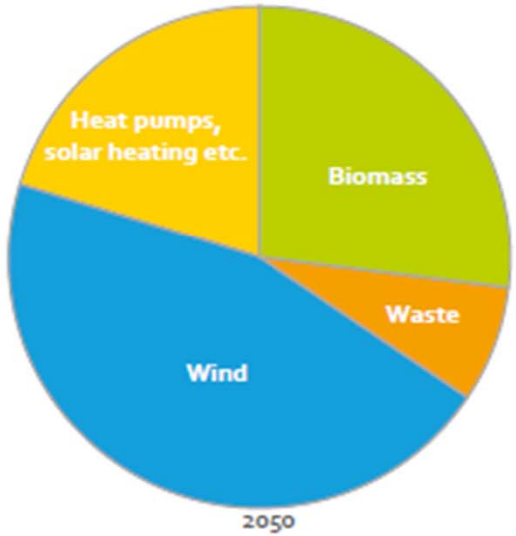
" We can both reduce Danish emissions of greenhouse gasses significantly, and make Denmark independent of fossil fuels. This will require a total conversion of the Danish energy system"

- *Danish Commission on Climate Change Policy*

What do we need to do....

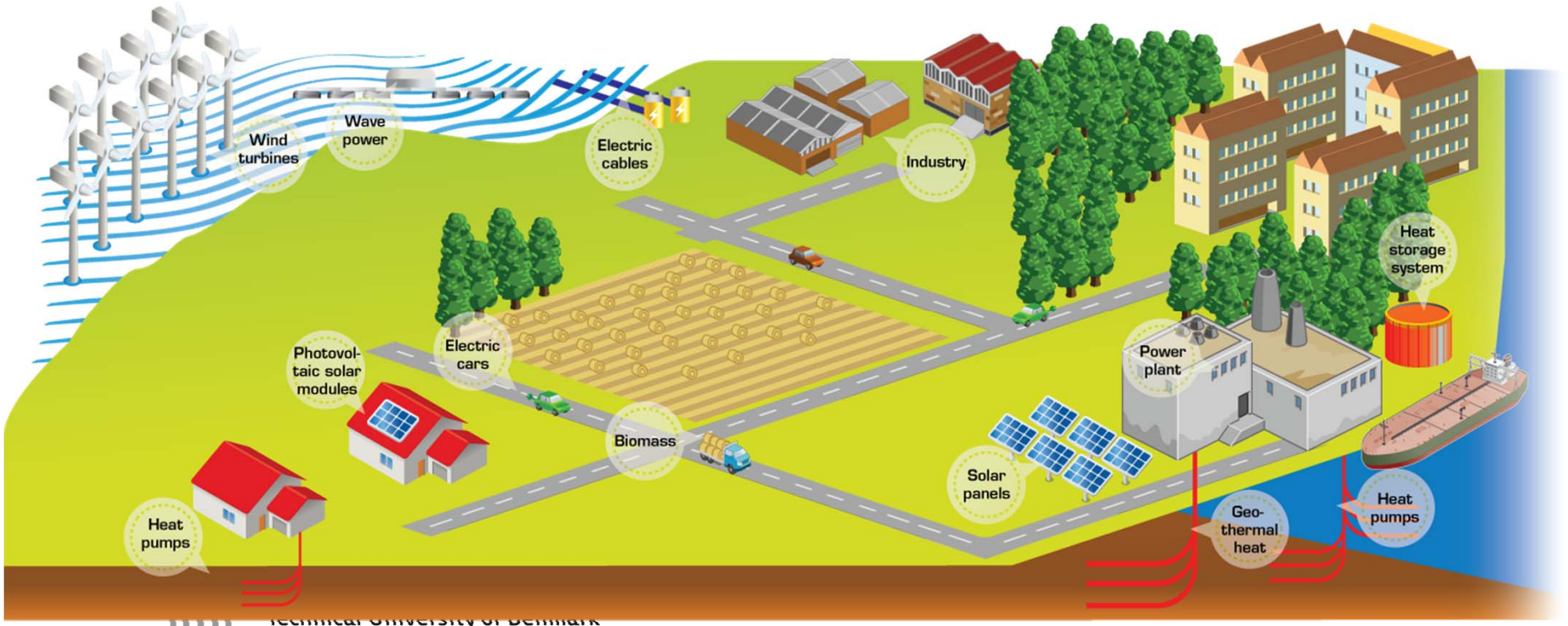
Main Future Trends:

- **An Energy System dominated by electricity**
- **Intermittent sources will have to play a large role**
  - *Wind Power Capacity x 6*
  - *Solar??*
- **The Resource of Biomass is limited**
- **Radical change in trans-port system**
  - *Electric cars, hydrogen, bio-ethanol.....?*

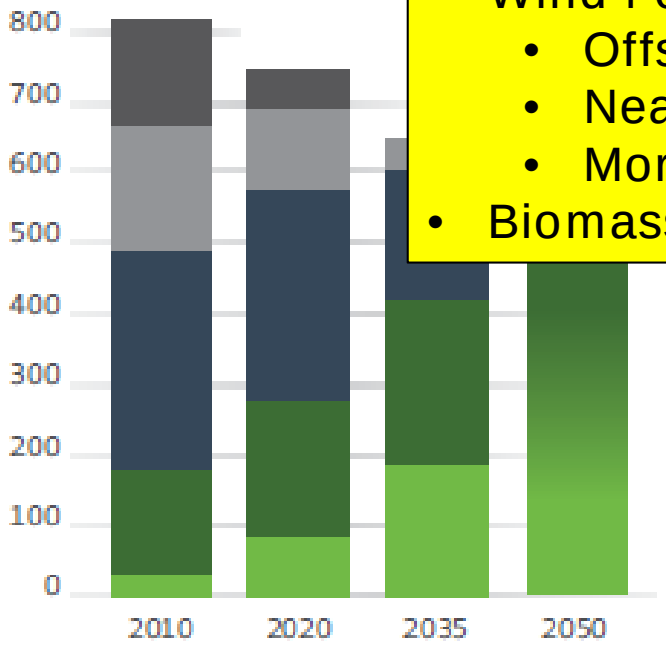


Source: Climate Commission

The Future Energy System



The Government's Energy Plan



Figur 3.8 Anvendelse af fossile brændsler og VE (PJ)

Until 2020 Parliament has agreed on:

- Energy Savings
- Wind Power
  - Offshore 1000 MW
  - Near Shore møller 500 MW
  - More Land based 500 MW
- Biomass in central power plants

sh Power
ed by Wind Power

al in Danish Power
es

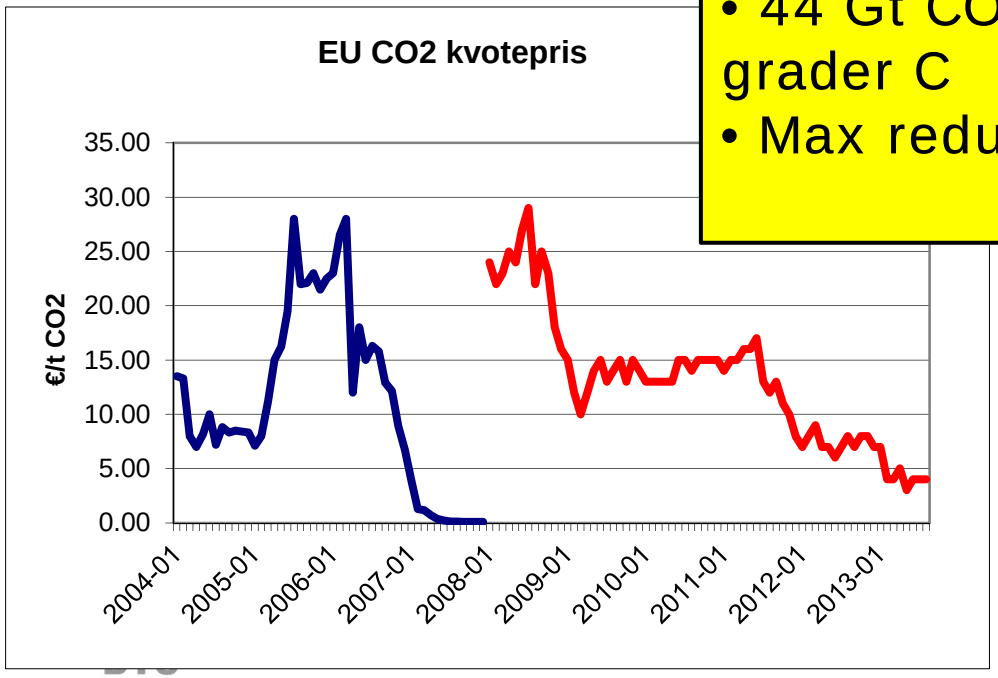
- **2035:** All heat and power consumption is supplied by renewables
- **2050:** The entire Danish energy consumption is supplied by renewables

Two Big Challenges

- **Climate Change**
- **Security of Supply**

Two Big Challenges

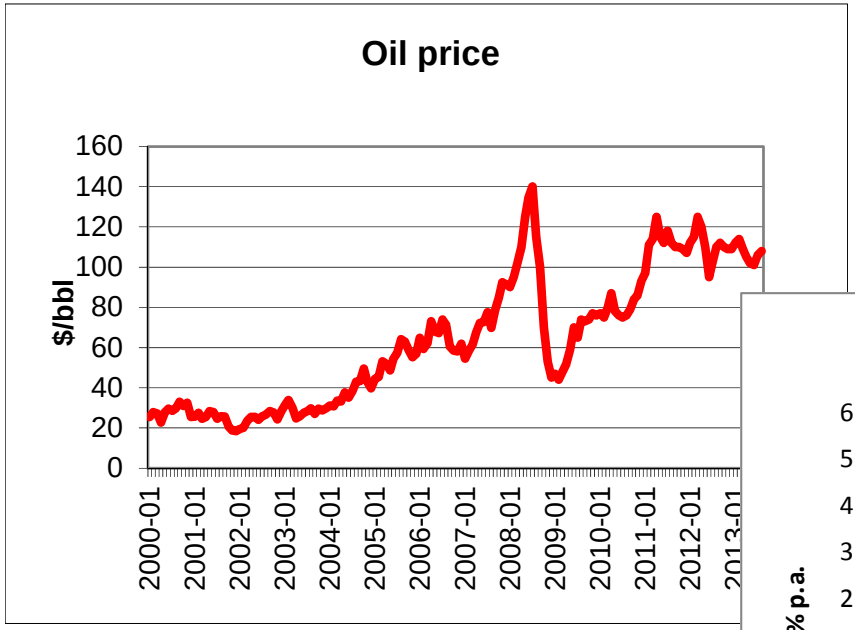
- **Climate Chan**
  - EU CO2-syst

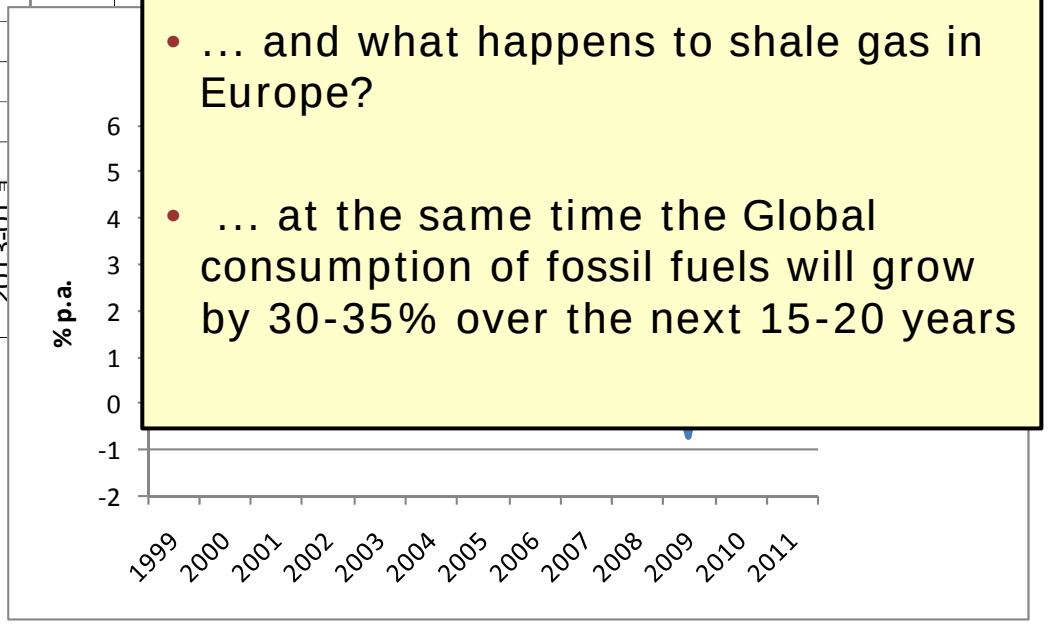


GAB-report on 2020

- 56 Gt CO2 in “business-as-usual”
- 44 Gt CO2 corresponding to2 grader C
- Max reduction 7 Gt CO2

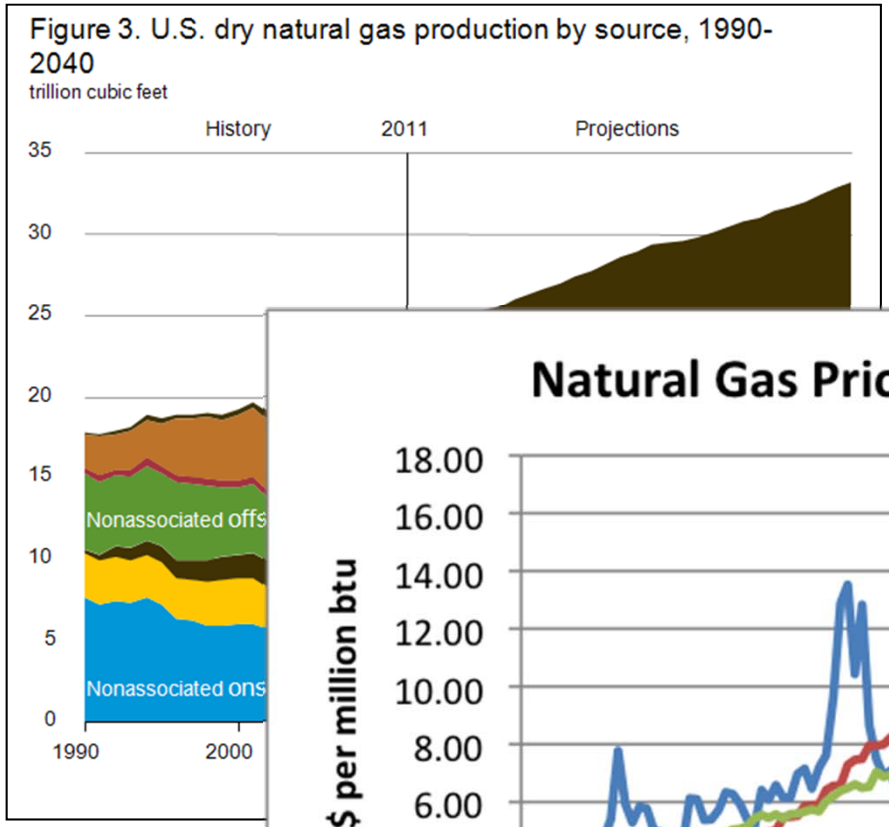
Two Big Challenge

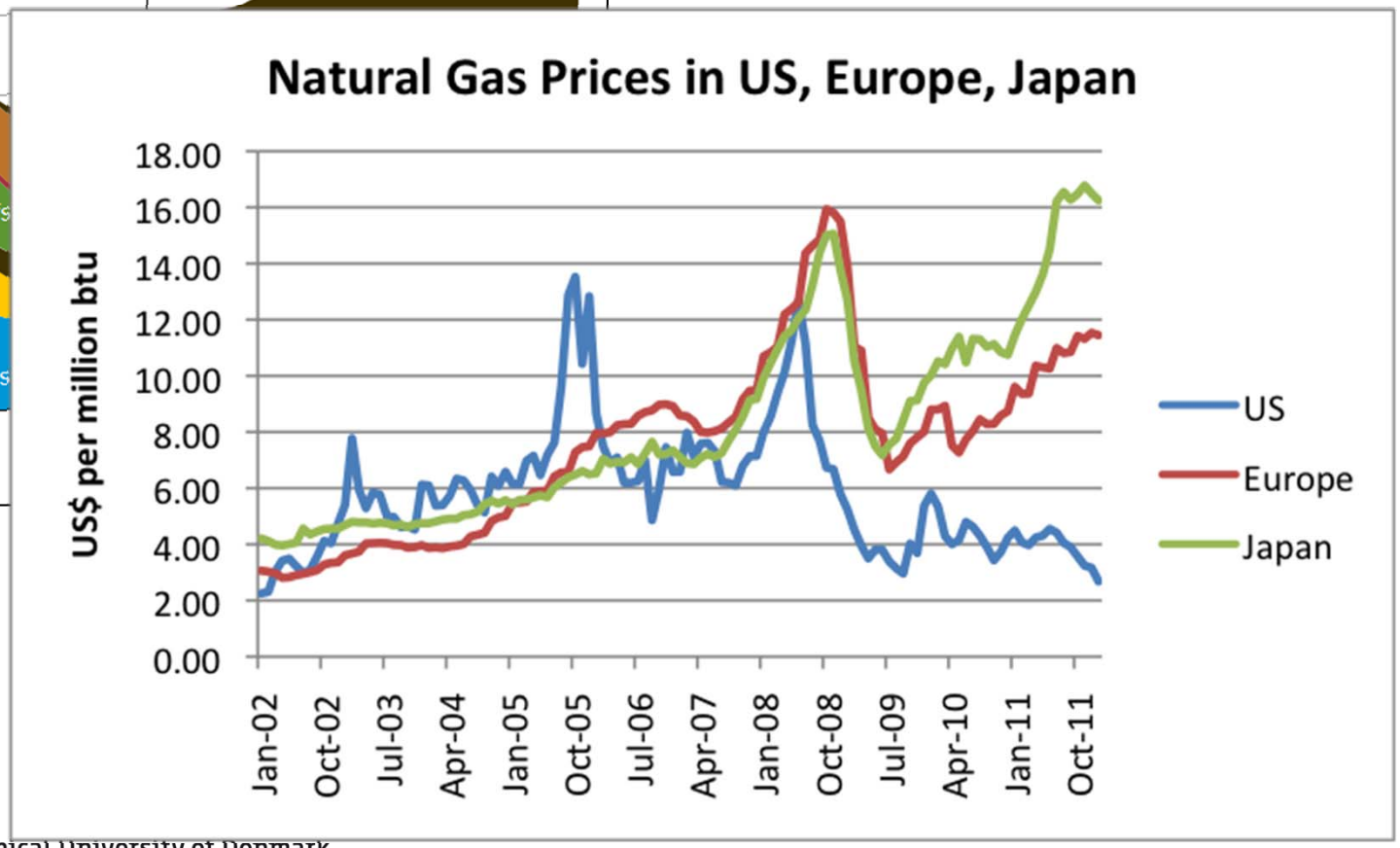




However……

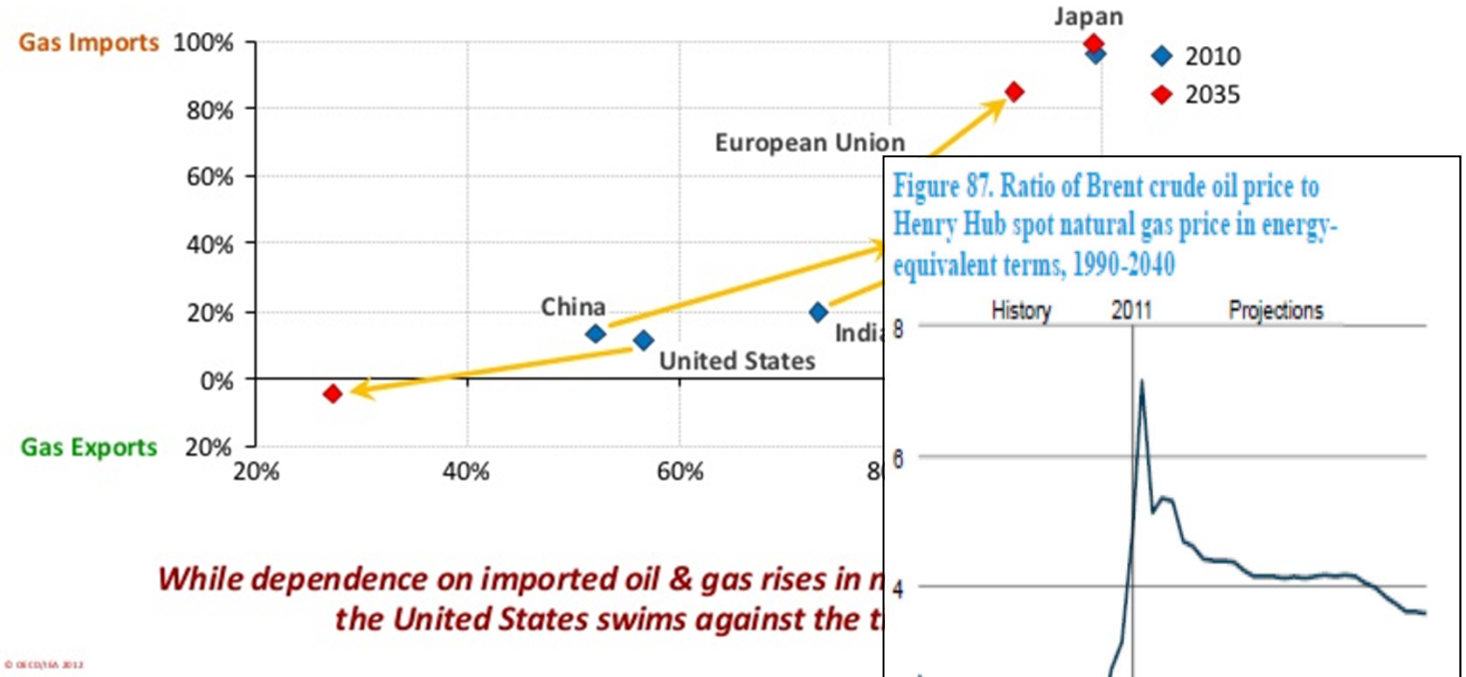
- New resources of gas and oil in the US will impact the global markets…
- … will USA become net-exporter of oil in 2030?
- … and what happens to shale gas in Europe?
- … at the same time the Global consumption of fossil fuels will grow by 30-35% over the next 15-20 years





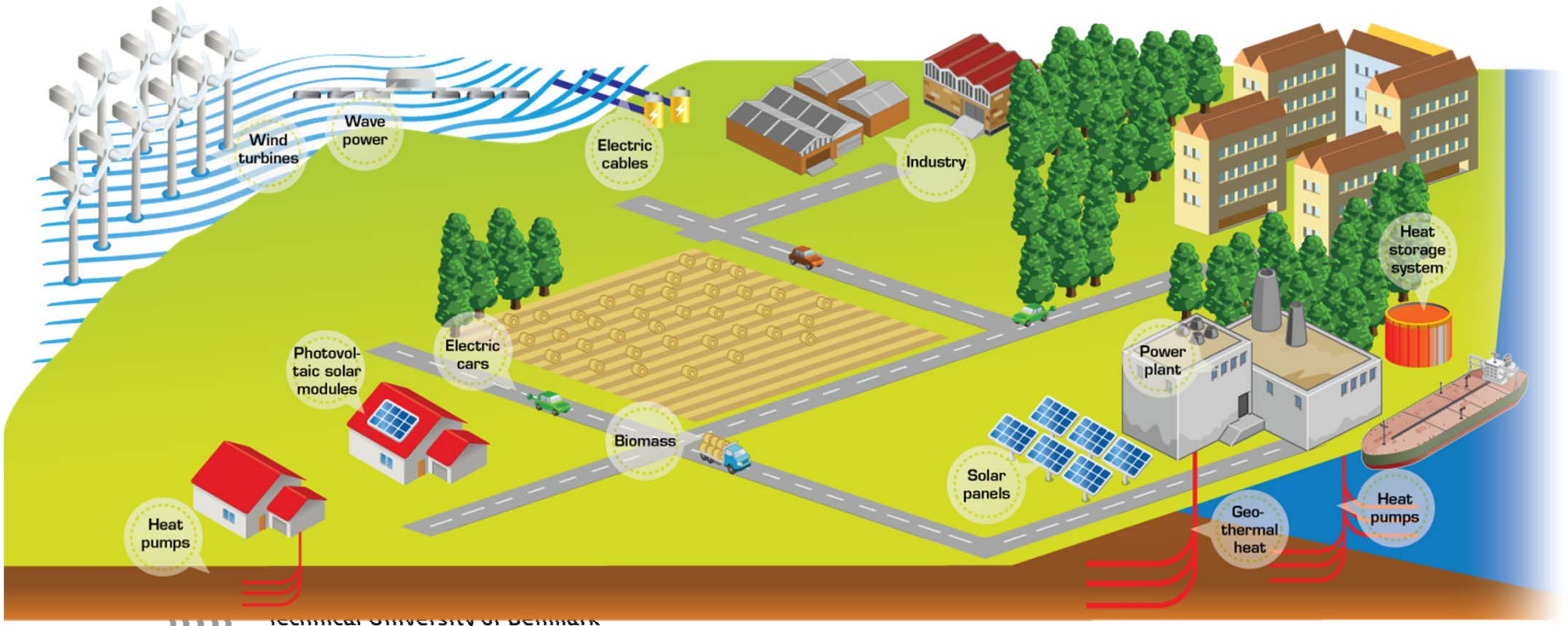
Source: DEA, US

Net oil & gas import dependency in selected countries



Source: DEA, US

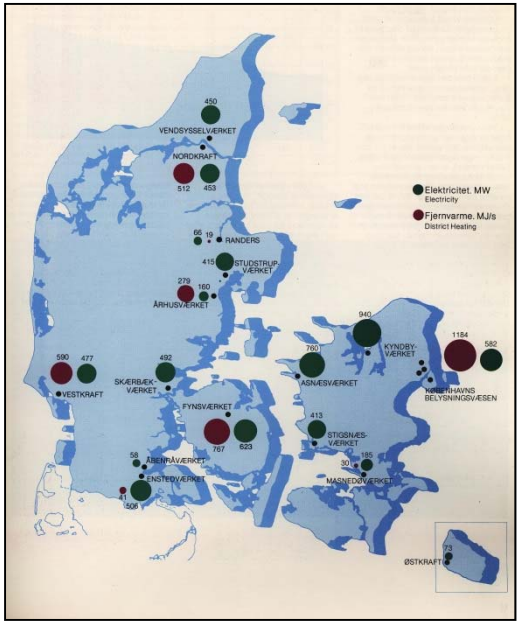
The Future Energy System

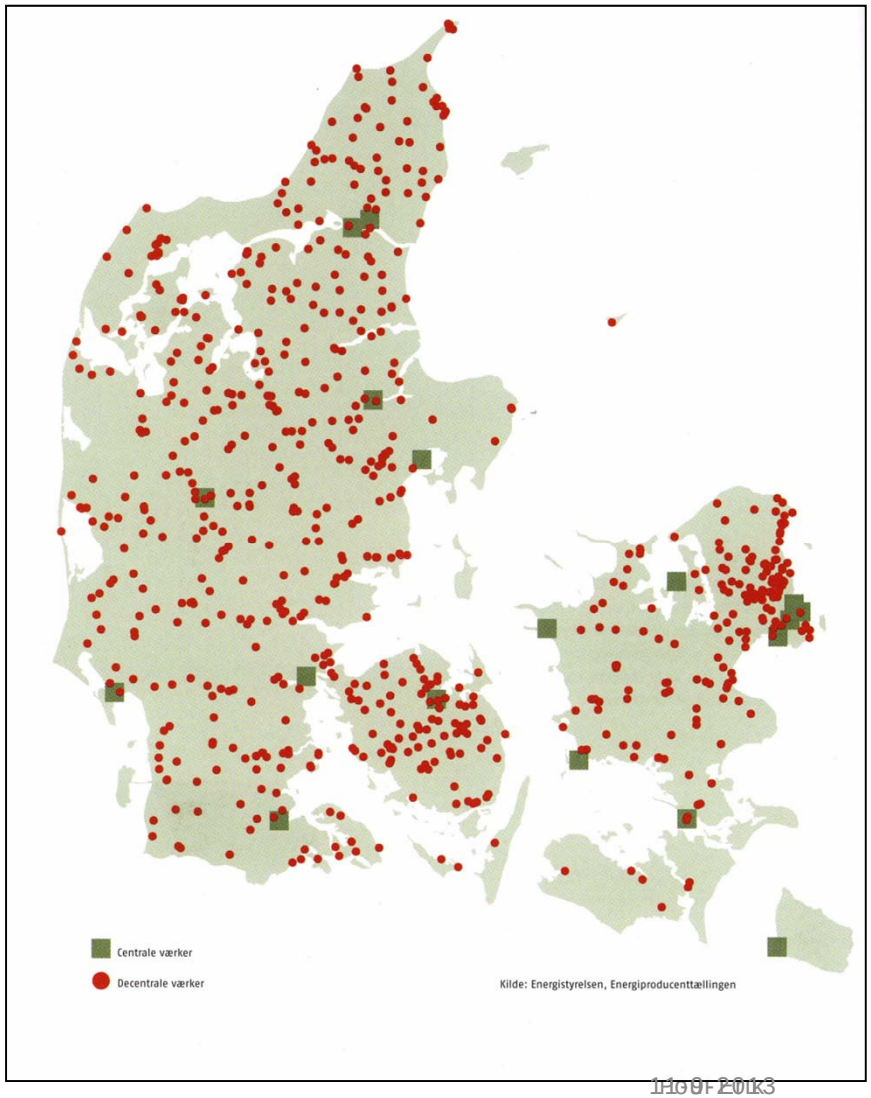


What is the future of our power plants?

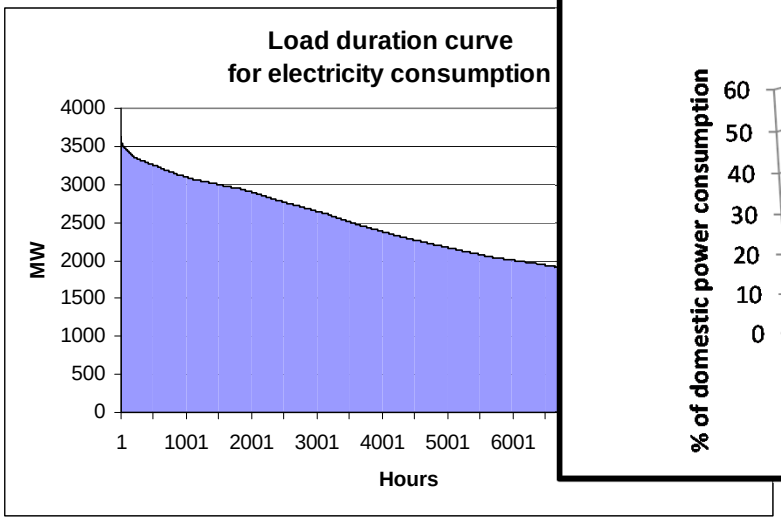
Today

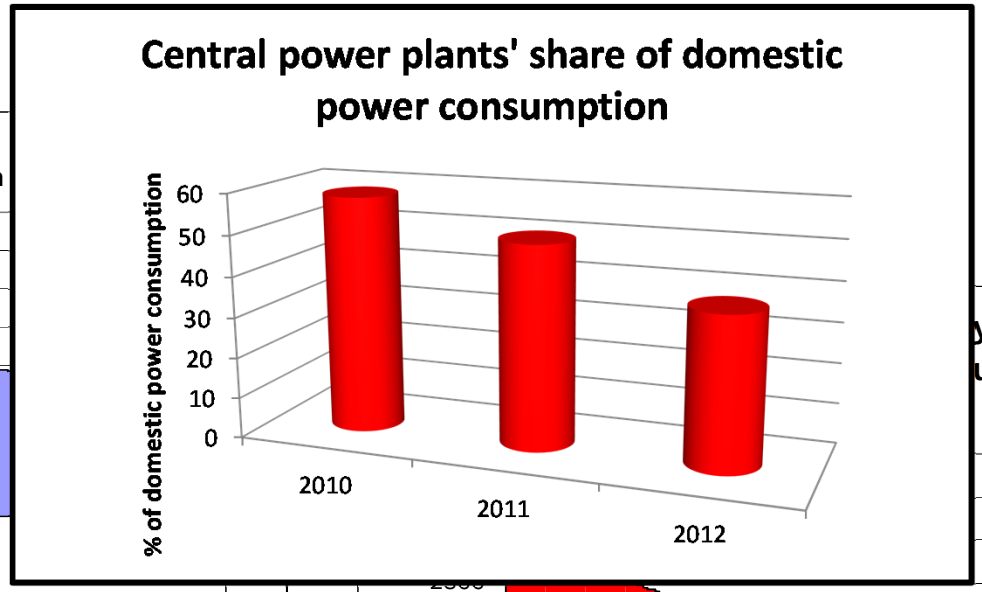
1980

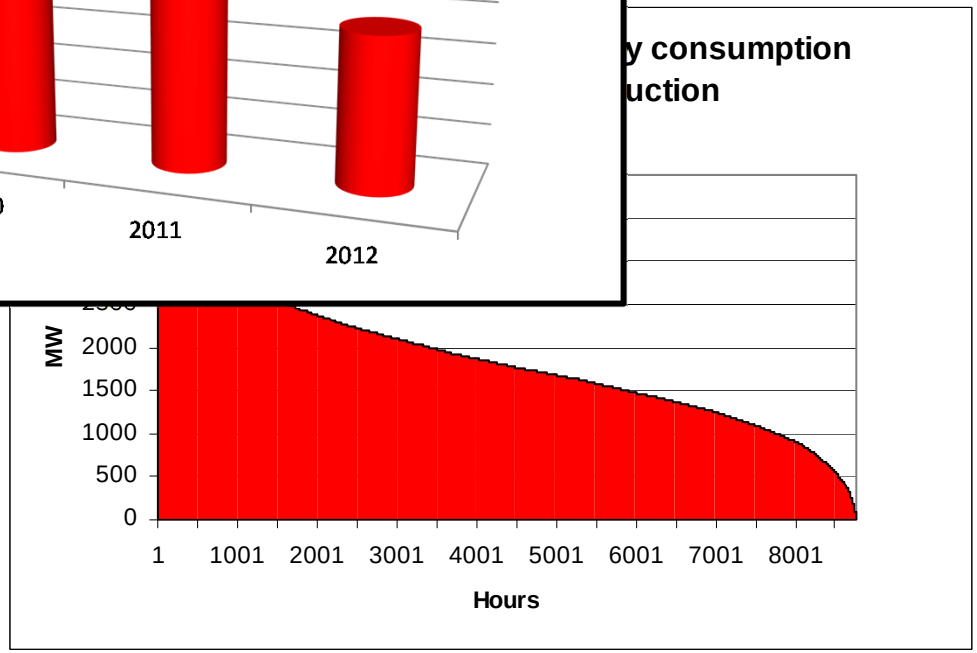


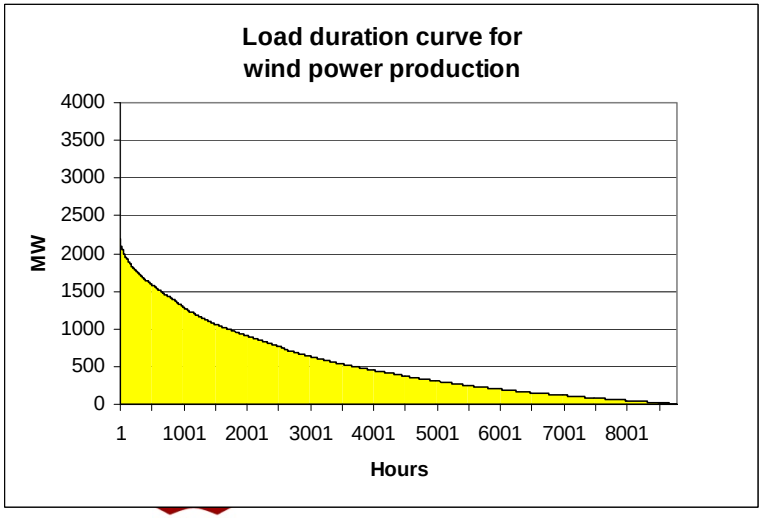


This have consequences for the energy system!





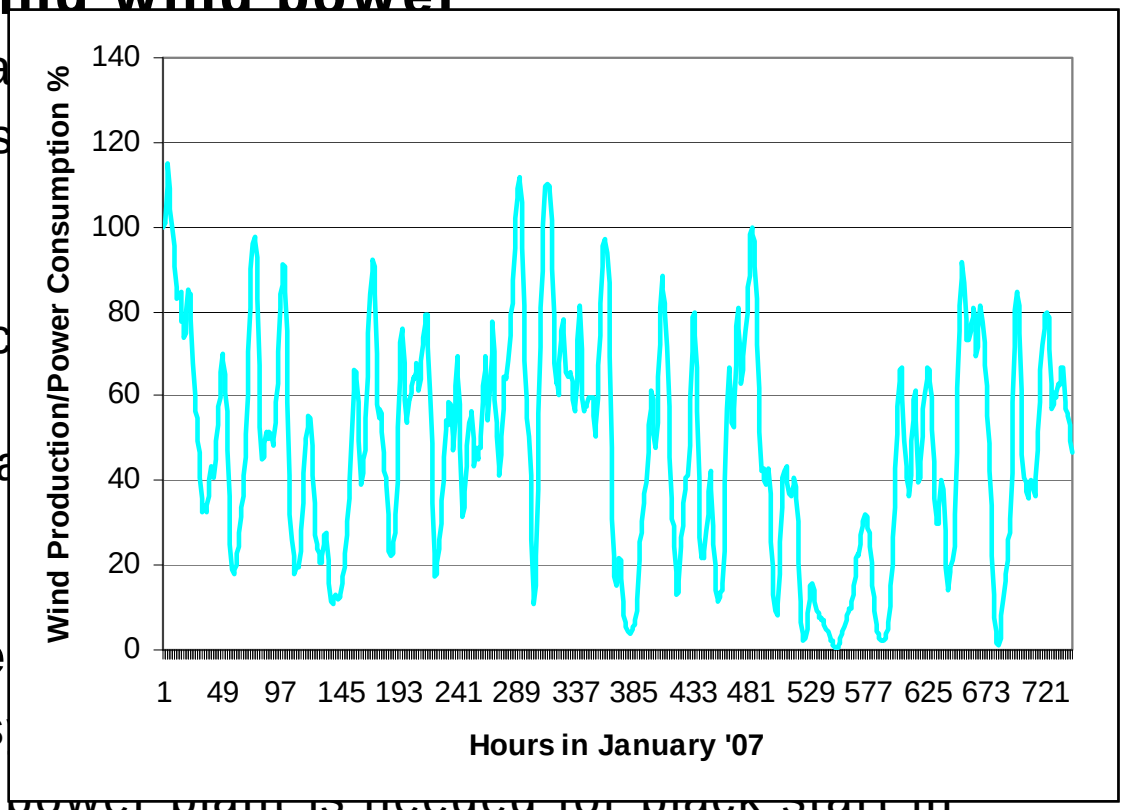




Poul Erik
Morthorst

Which requirements do we foresee to the power system in the transition phase?

- **Need for balancing wind power**
  - Interconnectors ca
  - Balancing power is
- **In periods with**
  - Central and/or dec biomass?
  - Will we politically a interconnectors?
- **Other system re**
  - New facilities for s
  - At least one large power plant is needed for black start in East and West Denmark



Where will we get the heat from?

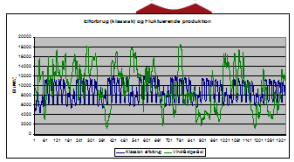
- **Without the central power plants we will have a deficit of heat in the big cities**
  - Heat pumps for district heating
  - Geothermal energy
  - Waste heat from industry and incineration plants

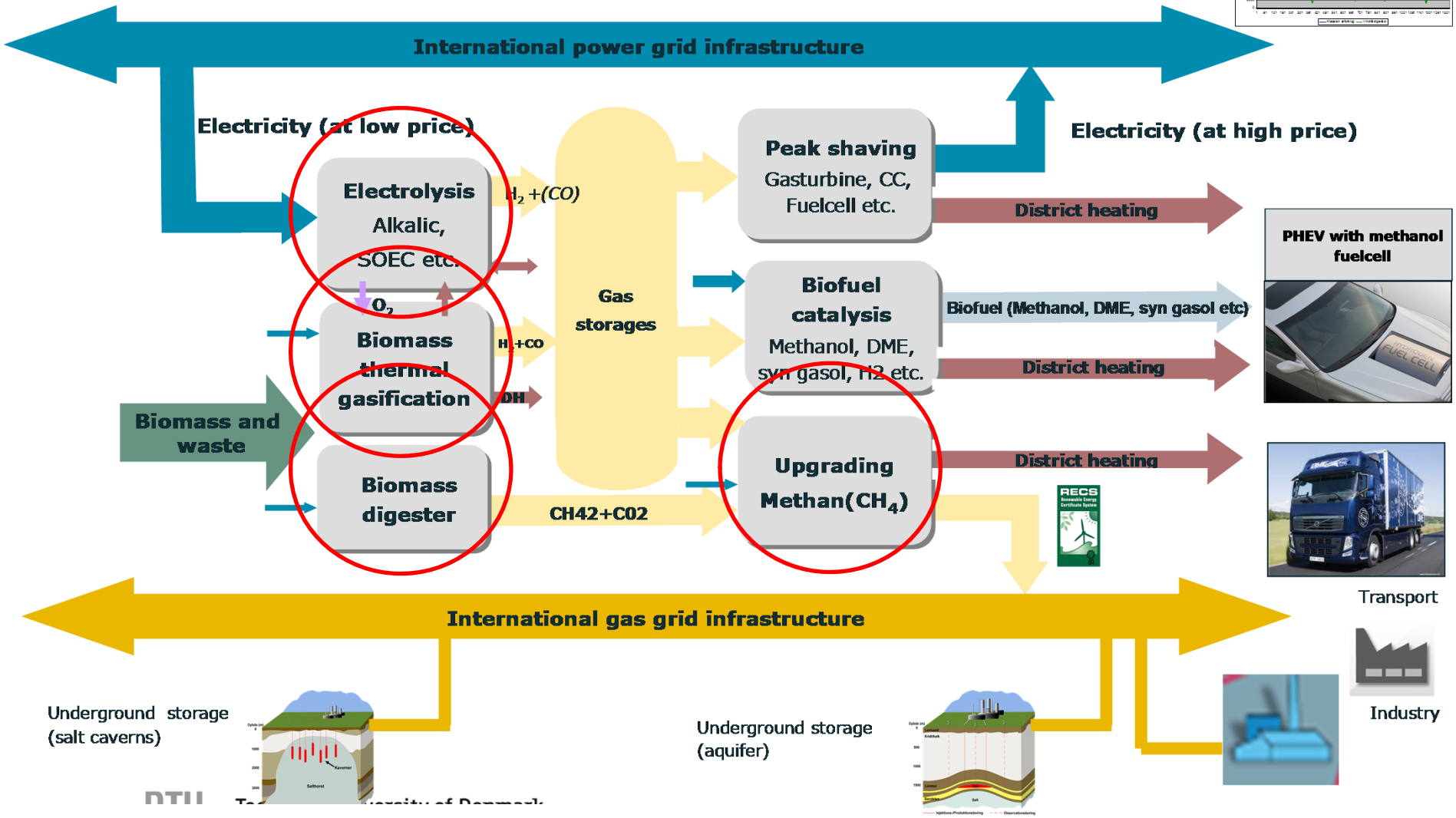
- **What about the decentralised power plants?**
  - Large problems when the fixed payment ("grundbeløbet") is running out in 2018
  - Solar heating
  - Heat pumps for decentralised use

Other needs to be fulfilled in the in the transition phase?

- **Storage facilities might be required**
  - Hydrogen is a possibility
  - Natural gas is probably the cheapest way for longer time storage
- **Reconsider natural gas in combined heat and power after 2035**
  - Could give robustness to the energy system
- **Natural gas is a good substitution for oil in industry and transport**

Integration of electricity, heat, gas and fuel-production





Source: Energinet.dk

Conclusions

- **The energy system will change drastically over the next 30-40 years**
  - Preconditions are changing
  - More higher wind share than today
  - Wind power will dominate the energy system
  - Fewer power plants
- **There will still be a role to play for large power plants**
  - Need for balancing, back-up and storage of intermittent resources
  - Will the large ones or the small ones survive?
- **New technologies are needed**
  - Fuel cell electrolysis, thermal gasification…
  - Where do we get the heat from? Heat pumps, geothermal energy, solar....
  - Complex interactions between power, gas, heat and transport……